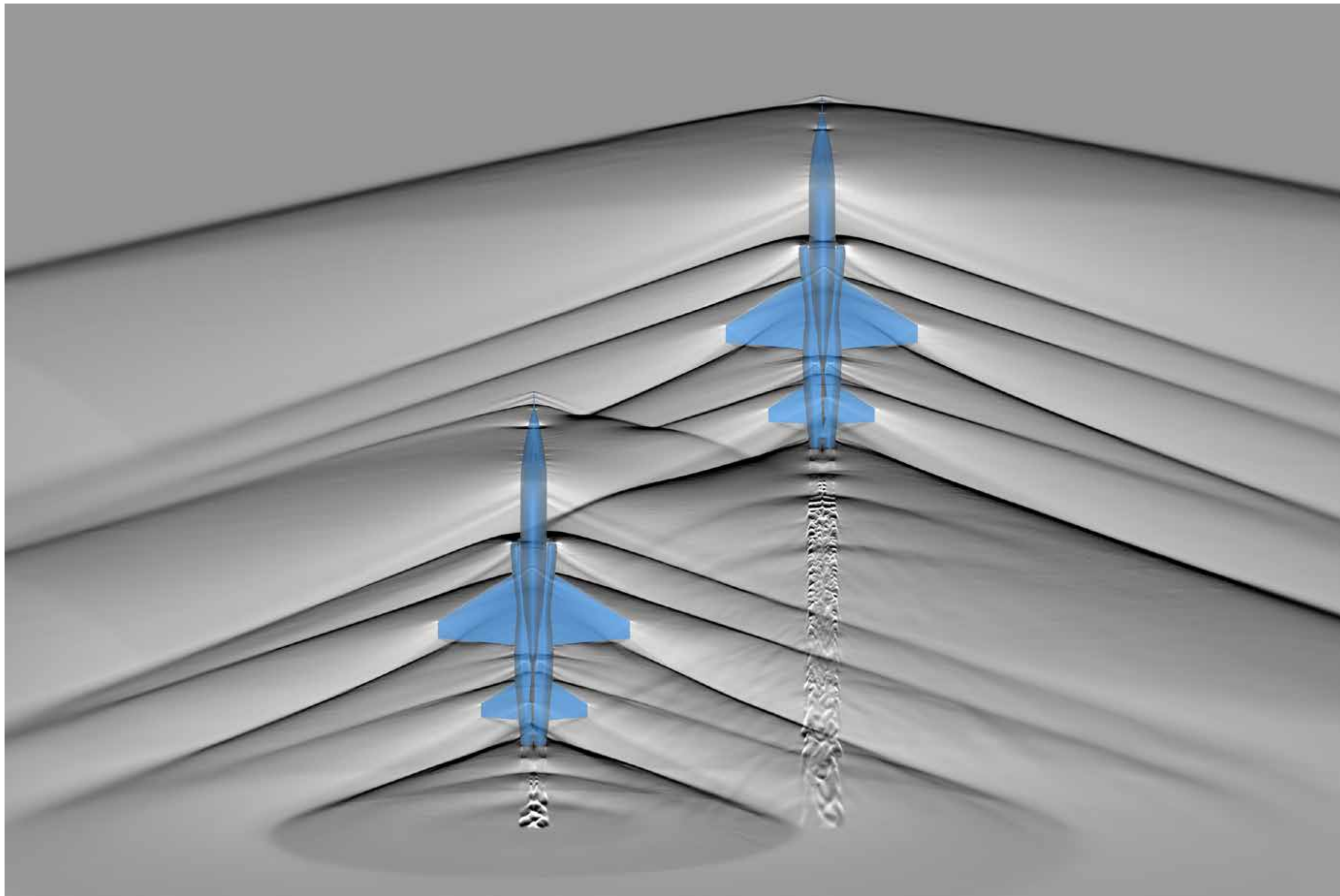


Computational schlieren image (similar to those produced by the schlieren technique in experiments) from a high-resolution Cart3D simulation. The dark and bright regions represent shockwaves and expansions, respectively. The complex shock system of the X-59 is shown, including the conical shocks behind the aircraft. The simulation includes propulsion effects, air probes, and secondary air system ducts. Significantly weaker shocks propagate from the lower surface of the aircraft, quieting sonic booms to sonic thumps on the ground. *Marian Nemec, Michael Aftosmis, NASA/Ames*



Schlieren flow visualization of supersonic T-38 aircraft flying in formation, generated from a high-resolution Cart3D simulation. In this birds-eye view, the interaction of shockwaves (black lines) and expansions (white regions) is clearly visible between the two aircraft. These simulations help improve flight test techniques in preparation for the X-59 overflights. *Marian Nemec, Patrick Moran, NASA/Ames*

## Minimizing Sonic Boom Through Simulation-Based Design: The X-59 Airplane

One of NASA's six Strategic Thrusts for aeronautics is "Innovation in Commercial Supersonic Aircraft," with a vision of fast air travel widely available to the traveling public. Future supersonic aircraft will be efficient, affordable, and environmentally responsible, generating an acceptable level of en-route noise (sonic booms). The first major step is the ongoing construction of the new X-59 Quiet SuperSonic Technology X-plane to demonstrate technologies that reduce sonic booms to gentle thumps. By using high-resolution Cart3D computational fluid dynamics simulations, the shape of the aircraft can be designed to control the non-linear interactions of shock waves to reduce the sonic boom noise on the ground to within outdoor ambient levels, thereby enabling supersonic overland flight.



*Marian Nemec, Michael Aftosmis, NASA Ames Research Center*